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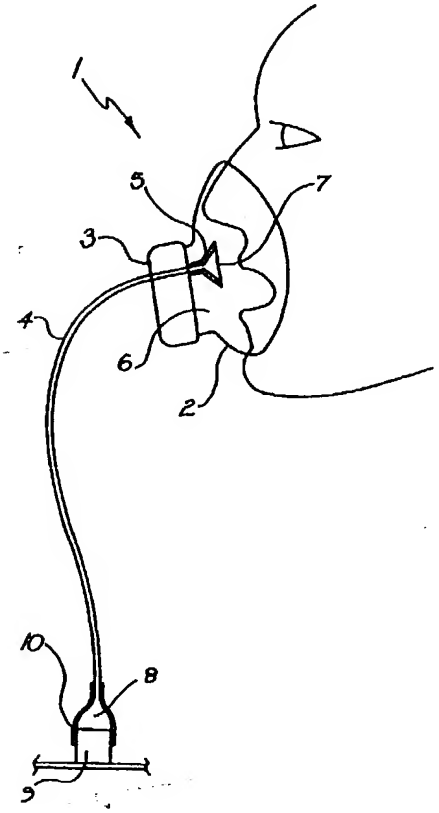
(54) Title: A COMMUNICATION INTERFACE FOR BREATHING EQUIPMENT

(57) Abstract

This invention concerns all types of breathing equipment, ranging from simple passive systems where air is drawn through a filter in a face-mask by the wearer's breathing action, to sophisticated powered systems which supply clean air at a regulated positive pressure. In all cases, because some form of face-mark or hood must be worn communication by the wearer is severely restricted. The invention provides breathing protection equipment including acoustic coupling to a remotely located microphone. The microphone may, for example, be contained together with its electrical supply and a transmitter in the wearer's breast pocket, and be connected with the face mask of the breathing protection equipment by means of a flexible sound pipe. These arrangements place the microphone, and all other electrical parts remotely from the mask. Among other things this facilitates regular cleaning of the mask, and may improve the reliability of the system generally.



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A COMMUNICATION INTERFACE FOR BREATHING EQUIPMENT

Technical Field

This invention concerns all types of breathing protection and diving equipment, ranging from simple passive systems where air is drawn through a filter in a face-mask by the wearer's breathing action, to sophisticated powered systems which supply clean air at a regulated positive pressure. In all cases, because some form of face-mask or hood must be worn, communication by the wearer is severely restricted.

Background

To address the problems of communication while wearing a breathing protection mask, electrical connectors and microphones have been introduced into the masks.

Disclosure of the Invention

The invention provides breathing equipment including a face part that in use is adjacent at least the mouth of the wearer, the face part being associated with acoustic coupling to a remotely located microphone. The breathing equipment may be used for breathing protection or diving applications.

The microphone may, for example, be contained together with its electrical supply and a transmitter in the wearer's breast pocket, and be connected with the face mask of the breathing protection equipment by means of a flexible sound pipe. These arrangements place the microphone, and all other electrical parts remotely from the mask. Among other things this facilitates regular cleaning of the mask, and may improve the reliability of the system generally.

The acoustic coupling may comprise a sound pipe which may be made of simple flexible tubing, such as tubing made from plastics materials.

A face mask may act as a pressure box and the upper end of the sound pipe can be positioned within the mask cavity. The sound pipe may enter the cavity through a port fabricated in the mask, or through the air supply valving.

Alternatively, the sound pipe may have a flared end to funnel the sound pressure waves caused by speech into the pipe.

A membrane may be provided over the upper end of the sound pipe to prevent moisture or other material from entering it.

At the lower end the sound pipe may be sealed into a package which also contains the microphone, to provide good transfer of the sound pressure to the microphone. The seal is preferably pneumatic, but if there were a small hole the system will still function. The pressure transmission medium in the pipe may be gaseous or liquid.

The cut off frequency for an acoustic coupling pipe is proportional to its diameter, and the medium in the pipe. A tube of 50mm diameter in air will have a cut off frequency of approximately 3KHz, which is just sufficient for the transfer of intelligible speech. An important advantage of the invention arises from having the speaker and the remote microphone both located in essentially the same pressure chamber. The pressure chamber is split into two compartments which are connected together by the acoustic coupling. The acoustic coupling may provide either an hydraulic or pneumatic link to maintain the two compartments at the same pressure, and this enables a pipe of small diameter to be utilised for the acoustic coupling. Specifically the diameter of the pipe may be less than that expected to be required by consideration of the diameter and the medium, because of the equal pressures at either end.

In order to cancel ambient noise, two microphones may be connected in a noise cancelling arrangement. The first microphone may pick up the noise plus the speech signals, and the second microphone may be arranged to pick up only the noise signals. An electronic circuit will subtract the two signals in order to provide a clean speech signal.

Brief Description of the Drawings:

An example of the invention will now be described with reference to:

Figure 1 which is a schematic illustration of an embodiment of the invention; and

Figure 2 which is a circuit diagram showing electrical treatment of the sound signals picked up by the embodiment of Figure 1.

Disclosure of the Best Modes of the Invention

Referring first to Figure 1 the breathing protection equipment 1 comprises a face mask 2 with some kind of air supply port 3. A sound pipe 4, comprising clear PVC having a inner diameter of 1.5mm, penetrates the mask and terminates in a flared funnel 5 within the mask cavity 6. A membrane 7 covers the open end of the funnel 5.

At the lower end, sound pipe 4 is pneumatically sealed in a cavity 8 together with a microphone 9, by means of an adaptor 10. By this means the sound pressure change inside the sealed breathing mask cavity 6 are pneumatically communicated to the sealed cavity 8 and microphone 9 via the air in the sound pipe 4.

A second microphone (not shown) is also associated with the lower end of the sound pipe, however, this microphone only picks up ambient noise and does not receive any of the sound communicated by sound pipe 4. Referring now to Figure 2, the speech and noise signal 11 from microphone 8 is fed to the non-inverting input of an amplifier 12, and the noise signal 13 picked up by the second microphone is fed to the inverting input of amplifier 12. Amplifier 12 subtracts the noise signal from the speech and noise signal to output a clean speech signal 14.

Although the invention has been described with reference to a particular example, it should be appreciated that it may be embodied in many other forms. In particular it should be appreciated that the invention is not restricted to breathing protection equipment of the type which involves use of a face mask, and it may be applied to those systems where there is no mask cavity, such as hoods or visors. In those situations the flare at the upper end of the sound pipe is adapted to provide a sound pick up (or collection) cavity. When a mask is used the flare may be dispensed with, since the mask cavity will act as a sound collector.

It should also be appreciated that the invention will operate with sound pipes of diameters with a broad range of inner diameters less than about 50mm. Inner diameters of between 1 and 5mm have been found to operate well. The sound pipe could also be used for air supply in which case a wider diameter could be used.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS:

1. Breathing equipment including a face part that, in use is adjacent at least the mouth of a wearer, the face part being associated with acoustic coupling means which provide acoustic coupling to a remotely located microphone.

2. Breathing equipment according to claim 1, wherein the breathing equipment is breathing protection equipment.

3. Breathing equipment according to claim 1, wherein the breathing equipment is breathing diving equipment.

4. Breathing equipment according to claims 1, 2 or 3, wherein the equipment comprises a mask, visor or hood.

5. Breathing equipment according to my preceding claim, wherein the acoustic coupling means comprises a sound pipe.

6. Breathing equipment according to claim 5, wherein the sound pipe is made of flexible tubing.

7. Breathing equipment according to claim 6, wherein the remote end of the sound pipe enters a compartment which also contains the microphone.

8. Breathing equipment according to claim 7, wherein the compartment together with the face part comprise a single pressure chamber.

9. Breathing equipment according to claim 5, wherein there is a gaseous or liquid pressure transmission medium in the sound pipe.

10. Breathing equipment according to claim 1, wherein the local end of the acoustic coupling, which is associated with the face part, terminates in a sound collector.

11. Breathing equipment according to claim 10, wherein a membrane is provided over the upper end of the sound pipe.

12. Breathing equipment according to claim 10, wherein the sound collector is a flared upper end of the sound pipe.

13. Breathing equipment according to claim 10, wherein the sound collector is a mouth covering mask.

14. Breathing equipment according to claim 13, wherein the sound pipe enters the mask through a port.

15. Breathing equipment according to claim 13, wherein the sound pipe enters the mask through inhalation or exhalation valving.

16. Breathing equipment according to any preceding claim, wherein two microphones are connected in a noise cancelling arrangement.

17. Breathing equipment according to claim 16, wherein a first microphone picks up noise plus speech signals, and a second microphone is arranged to pick up only the noise signals; an electronic circuit subtracts the two signals in order to provide a clean speech signal.

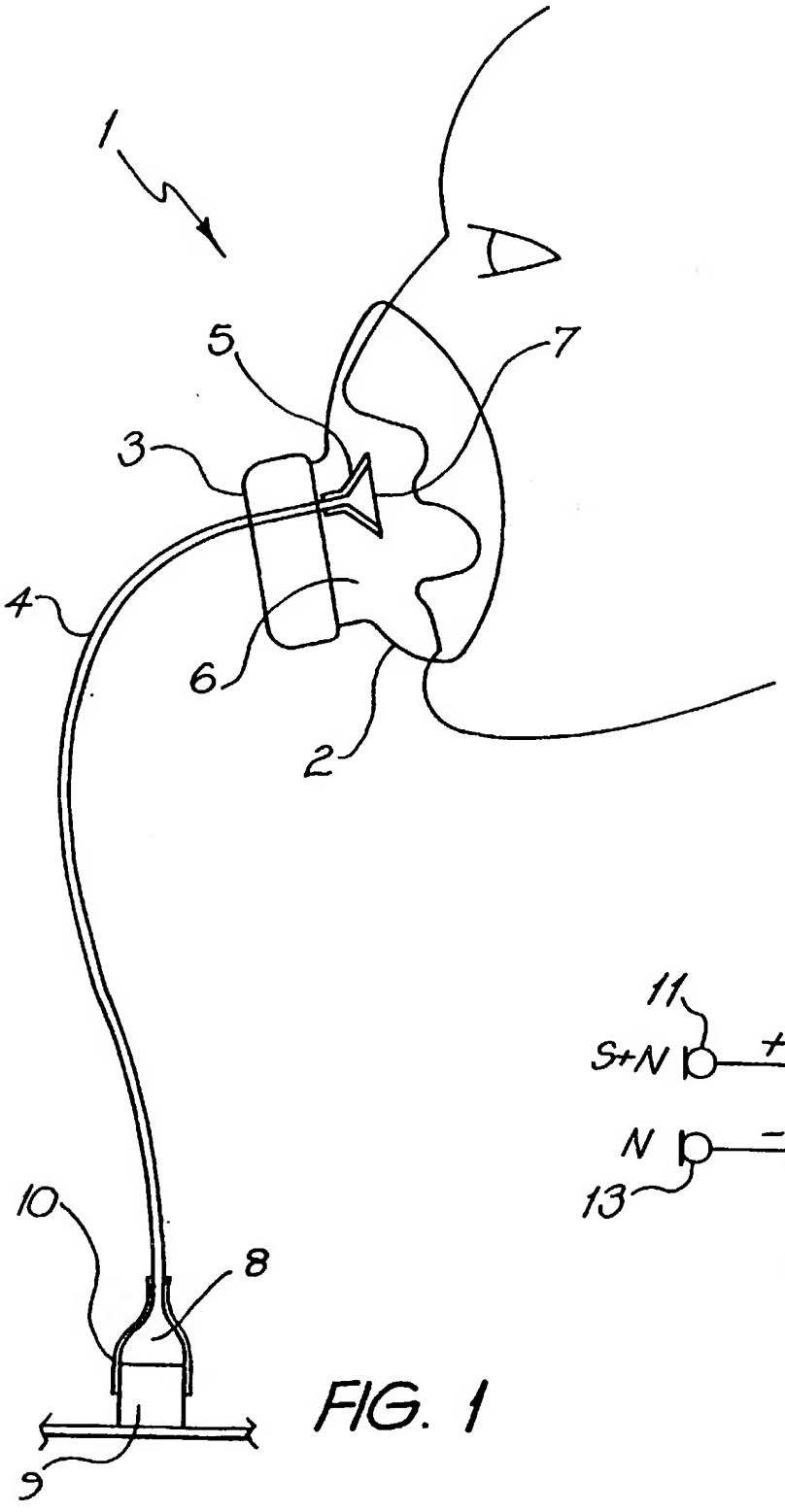

FIG. 1

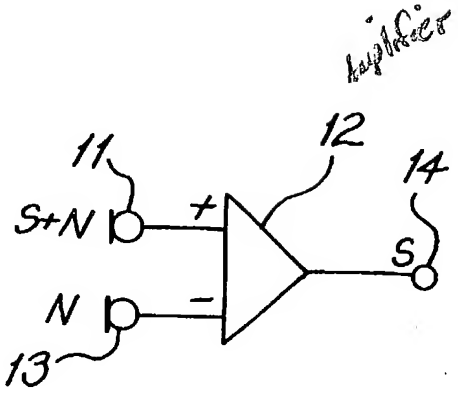

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00216

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A62B 18/08, B63C 11/26, G10K 11/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC, A62B 18/08, B63C 11/26, A61M 16/06, A42B 3/28, 3/30, G10K 11/12, G10K 11/22

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT, JAPIO; (Mask or Visor or Hood or Breath:) and (microphone) and (coupl: or pipe or tube)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, 4537276 A (CONFER) 27 August 1985 Abstract	1-17
X	US, 3184556 A (LARKIN) 18 May 1965 entire specification	1-17
X	GB 2084428 A (GENTEX CORPORATION) 7 April 1982 Abstract, page 2 lines 45-51, page 3 lines 56-70	1-4, 10, 13, 16, 17

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
19 May 1997	23 MAY 1997

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C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO, 94/05372 A BRETAGNE RADIO COMMUNICATIONS) 17 March 1994 Abstract, page 3 line 7, page 4 line 3	1-17
X	WO, 91/12051 A1 (HOK INSTRUMENT AB) 22 August 1991 Abstract, page 2	1, 2, 4-10, 12-17
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X	WO, 82/03160 A1 (CHAISE, Francois) 30 September 1982 Abstract	1, 4-17
X	FR, 828843 A (DECOMBE) 31 May 1938 entire specification	1-17
A	US, 4013992 A (DEWBERRY et al) 22 March 1977 Abstract	
A	GB, 2058578 A (The Secretary of State for Defence) 15 April 1981 Abstract	
A	EP, 377316 A2 (NOETZEL) 11 July 1990 Abstract	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 97/00216

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
GB	2084428	DE	3137113	FR	2490431	IT	1138220
		US	4374301				
WO	9405372	FR	2695039				
WO	9112051	AU	72472/91	EP	534975	SE	9000552
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WO	9107859	EP	452486	JP	4504346	US	5138666
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		FR	2510793				
EP	377316	CA	2005351	US	4980926	ZA	8909661

END OF ANNEX